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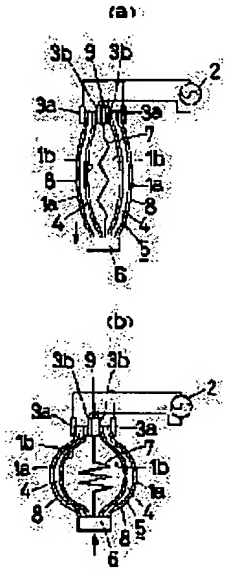
(54) ACTUATOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an actuator which can provide rectilinear action without fail, and can keep the form after being operated.
SOLUTION: This actuator is constituted by providing an actuator body 5, which has an elastic element 1 consisting of π-conjugate high polymer material such as polyanine, polypyrrole, or the like, a power source part 2 and a voltage application part 3 (3a and 3b) for applying voltage to the elastic element 1, and an electrolytic part 4 for leading current to the outside from the elastic element 1, and in which the elastic element 1 expands when positive potential is applied to the voltage application part 3 and the elastic element 1 shrinks, when negative potential is applied to the voltage application part 3, with a mover 6 which is operated rectilinearly by the expansion and contraction of the elastic element 1.



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審査請求　未請求　請求項の数８　ＯＬ　（全８頁）

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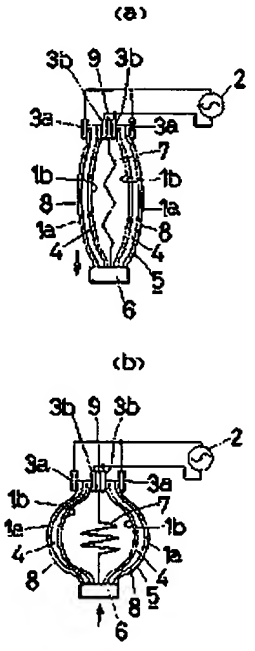
(54)【発明の名称】　アクチュエータ

(57)【要約】
【課題】　直線的な動作を確実に得ることができ、動作された後の形態を持続させることもできるアクチュエータを提供する。
【解決手段】　ポリアニン、ポリピロール等のπ共役型高分子材料でなる伸縮素子１と、伸縮素子１に電圧を印加するための電源部２及び電圧印加部３と、電流を伸縮素子１から外部に導通させるための電解質部４と、を有し、電圧印加部３に正の電位を印加すると伸縮素子１が伸張し、電圧印加部３に負の電位を印加すると伸縮素子１が収縮するようになしたアクチュエータ本体５に、伸縮素子１の伸縮によって直線的に動作される移動部６を設けてなる。



【特許請求の範囲】

【請求項１】　ポリアニン．ポリピロール等のπ共役型高分子材料でなる伸縮素子と、該伸縮素子に電圧を印加するための電源部及び電圧印加部と．電流を伸縮素子から外部に導通させるための電解質部と．を有し．電圧印加部に正の電位を印加すると伸縮素子が伸張し．電圧印加部に負の電位を印加すると伸縮素子が収縮するようになしたアクチュエータ本体に、伸縮素子の伸縮によって直線的に動作される移動部を設けてなるアクチュエータ。

【請求項２】　伸縮素子の伸張時に移動部が動作される方向への力を発生するばね等のバイアス機構を備えたことを特徴とする請求項１記載のアクチュエータ。

【請求項３】　電解質部の両側に伸縮素子を接合一体化して板状積層体を形成し．一方の伸縮素子に対応する電圧印加部に正の電位を印加すると共に．他方の伸縮素子に対応する電圧印加部に負の電位を印加することにより．一方の伸縮素子が伸張すると同時に他方の伸縮素子が収縮して、同板状積層体が屈曲変形されるようになし．該屈曲変形によって移動部が直線的に動作されるようになしたことを特徴とする請求項１記載のアクチュエータ。

【請求項４】　対の板状積層体を対向位置に配設して両板状積層体を端部で結合一体化し、該結合部分に同板状積層体の板面と略沿う方向で直線的に動作される移動部を設けたことを特徴とする請求項３記載のアクチュエータ。

【請求項５】　板状積層体の中程部分に、該板状積層体の板面と略直交する方向で直線的に動作される移動部を設けたことを特徴とする請求項３記載のアクチュエータ。

【請求項６】　板状積層体をその一方の伸縮素子が外周．他方の伸縮素子が内周となる円環状に形成し．該円環状となる板状積層体の周方向における一部分を．同板状積層体の径方向で直線的に動作される移動部となしたことを特徴とする請求項３記載のアクチュエータ。

【請求項７】　伸縮素子をスパイラル状に形成し．該伸縮素子のスパイラル曲線に沿う伸縮により同スパイラルの軸線方向に沿って直線的に動作される移動部を．同伸縮素子の端部に設けたことを特徴とする請求項１記載のアクチュエータ。

【請求項８】　伸縮素子の伸張時に移動部が動作される方向への力を発生するスパイラル状のスプリングであるバイアス機構を備え、該バイアス機構に沿って伸縮素子を一体化したことを特徴とする請求項７記載のアクチュエータ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は．電解質部の環境内で電圧を印加すると伸縮する伸縮素子によって直線的な動作を得るアクチュエータに関するものである。

【０００２】

【従来の技術】従来から．特開平６－６９９１号公報に示されるようなアクチュエータは知られている。該アクチュエータは．図８に示す如く、イオン交換膜15の両面に電極16を接合し、これ等を被覆するポリマー材料層17を設けてなるものである。この場合．イオン交換膜15として陽イオン交換膜或いは陰イオン交換膜のいずれをも使用することができ、陽イオン交換膜としては．ポリスチレンスルホン酸膜、スルホン基やカルボキシル基をもつフッ素樹脂系イオン交換膜等が用いられ、陰イオン交換膜としては．アンモニウム基を含んだフッ素樹脂系イオン交換膜その他が用いられる。又．ポリマー材料層17は薄い被膜であり、ポリエチレン、ポリスチレン．ポリアミド等の水不溶性ポリマーでなる。

【０００３】したがって．該アクチュエータにおいては．電源部２によって電圧を両電極16に印加することで．イオン交換膜15の表裏に電位差がかかって該表裏での水分量に差を生じ、同イオン交換膜15は含水率の低い側が収縮して該低い側（陰極側）へ湾曲変形する。このような変形動作をなす同アクチュエータは、例えば、超小型ロボット用の人工筋肉等の動力発生機構として利用することができる。

【０００４】

【発明が解決しようとする課題】しかしながら．上記従来の技術においては、ポリマー材料層17も電圧の印加によって伸縮することになるが、この場合、電圧印加時の立ち上がり電流にのみ反応しすぐに元へと戻ってしまうものであった。すなわち．電圧を印加しても、イオン交換膜15内の電流が減少すれば、一旦生じた含水率の分布は徐々に平均化されて行くため、湾曲変形状態が元の状態へと戻ってしまうものであった。それ故に、伸張或いは収縮された状態を持続させるためには、繰り返し電圧を印加し続けなければならないという問題があった。

又．イオン交換膜15の含水率の低い側の収縮によってのみアクチュエータは変形動作をなすものであるため、該変形動作を得るに必要な同収縮時の発生力が弱いという問題もあった。

【０００５】本発明は、上記従来の技術における問題を悉く解決するために発明されたもので．その課題は、直線的な動作を確実に得ることができ．しかも、該動作された後の形態を．繰り返し電圧印加し続けることなく持続させることができるアクチュエータを提供することである。

【０００６】

【課題を解決するための手段】本発明の請求項１記載のアクチュエータは、ポリアニン、ポリピロール等のπ共役型高分子材料でなる伸縮素子と、該伸縮素子に電圧を印加するための電源部及び電圧印加部と、電流を伸縮素子から外部に導通させるための電解質部と、を有し、電

圧印加部に正の電位を印加すると伸縮素子が伸張し、電圧印加部に負の電位を印加すると伸縮素子が収縮するようになしたアクチュエータ本体に、伸縮素子の伸縮によって直線的に動作される移動部を設けてなる。

【０００７】したがって、この場合、電圧印加部に正、負の電位が印加されることによってπ共役型高分子材料でなる伸縮素子は酸化還元反応作用により強力に伸縮し、すなわち、電圧印加部に正の電位を印加すると伸縮素子のイオンドーピング量が増大して該伸縮素子は伸張し、逆に、電圧印加部に負の電位を印加すると伸縮素子のイオンドーピング量が減少して該伸縮素子は収縮し、これによって確実にアクチュエータ本体に設けられる移動部が直線的に動作される。しかも、同伸縮素子はその伸張或いは収縮された状態を電圧印加部に正、負逆の電位が印加されるまで保持するので、動作されたアクチュエータ本体の形態を繰り返し電圧印加し続けることなく確実に持続させることができる。

【０００８】本発明の請求項２記載のアクチュエータは、上記請求項１記載のアクチュエータにおいて、伸縮素子の伸張時に移動部が動作される方向への力を発生するばね等のバイアス機構を備えたことを特徴とする。

【０００９】したがって、この場合は特に、電圧印加部に正の電位が印加されて伸縮素子が伸張される際の該伸張力は逆の際の収縮力よりも弱くなるものであるが、バイアス機構によって伸縮素子の伸張時に移動部が動作される方向への力が発生されるので、伸縮素子が伸張される際にも充分な動作力を得ることができる。又、伸縮素子が収縮される際の該収縮力は比較的強いので、前記バイアス機構の発生力に抗し支障なく同伸縮素子が収縮して移動部は前記と逆の方向へ動作される。

【００１０】本発明の請求項３記載のアクチュエータは、上記請求項１記載のアクチュエータにおいて、電解質部の両側に伸縮素子を接合一体化して板状積層体を形成し、一方の伸縮素子に対応する電圧印加部に正の電位を印加すると共に、他方の伸縮素子に対応する電圧印加部に負の電位を印加することにより、一方の伸縮素子が伸張すると同時に他方の伸縮素子が収縮して、同板状積層体が屈曲変形されるようになし、該屈曲変形によって移動部が直線的に動作されるようになしたことを特徴とする。

【００１１】したがって、この場合は特に、電圧印加部に正、負の電位が印加されることによって、板状積層体の一方の伸縮素子が伸張すると同時に他方の伸縮素子が収縮し、これにより該板状積層体が屈曲変形されることによって移動部は直線的に動作されるので、電圧印加部に正、負逆の電位を印加して同板状積層体を反対側へ屈曲変形させる際にも同様の動作力が発生し、簡単な機構でもって移動部を確実に往復運動させることができる。

【００１２】本発明の請求項４記載のアクチュエータは、上記請求項３記載のアクチュエータにおいて、対の

板状積層体を対向位置に配設して両板状積層体を端部で結合一体化し、該結合部分に同板状積層体の板面と略沿う方向で直線的に動作される移動部を設けたことを特徴とする。

【００１３】したがって、この場合は特に、上記板状積層体が対向配置されて両者の端部で結合一体化され、該結合部分に同板状積層体の板面と略沿う方向で直線的に動作される移動部が設けられているので、該移動部を両側の板状積層体の屈曲変形によって確実に安定した状態で往復運動させることができる。

【００１４】本発明の請求項５記載のアクチュエータは、上記請求項３記載のアクチュエータにおいて、板状積層体の中程部分に、該板状積層体の板面と略直交する方向で直線的に動作される移動部を設けたことを特徴とする。

【００１５】したがって、この場合は特に、上記板状積層体の中程部分に、該板状積層体の板面と略直交する方向で直線的に動作される移動部が設けられているので、該移動部を単一の同板状積層体でもってこれと略直交する方向に往復運動させることができる。

【００１６】本発明の請求項６記載のアクチュエータは、上記請求項３記載のアクチュエータにおいて、板状積層体をその一方の伸縮素子が外周、他方の伸縮素子が内周となる円環状に形成し、該円環状となる板状積層体の周方向における一部分を、同板状積層体の径方向で直線的に動作される移動部となしたことを特徴とする。

【００１７】したがって、この場合は特に、上記板状積層体が円環状に形成され、その周方向における一部分が径方向で直線的に動作される移動部となるので、該移動部と反対側で径方向に対向する同板状積層体の一部分を固定するだけの簡単な構造となり、同移動部を円環状の板状積層体が膨大縮小する屈曲変形によって確実に安定した状態で往復運動させることができる。

【００１８】本発明の請求項７記載のアクチュエータは、上記請求項１記載のアクチュエータにおいて、伸縮素子をスパイラル状に形成し、該伸縮素子のスパイラル曲線に沿う伸縮により同スパイラルの軸線方向に沿って直線的に動作される移動部を、同伸縮素子の端部に設けたことを特徴とする。

【００１９】したがって、この場合は特に、伸縮素子がスパイラル状に形成されてコンパクトに納まり、しかも、該伸縮素子はスパイラル曲線に沿って大きな変位量で伸縮して、該大きな変位量の伸縮が同スパイラルの軸線方向に沿った小さな変位量となる移動部の直線的な動作に変換されるので、より強い動作力を得ることができる。

【００２０】本発明の請求項８記載のアクチュエータは、上記請求項７記載のアクチュエータにおいて、伸縮素子の伸張時に移動部が動作される方向への力を発生するスパイラル状のスプリングであるバイアス機構を備

え．該バイアス機構に沿って伸縮素子を一体化したことを特徴とする。

【００２１】したがって．この場合は特に、上記スパイラル状の伸縮素子がスプリングであるバイアス機構に沿ってこれと一体化形成されるので、該バイアス機構によって伸縮素子の伸張時に移動部が動作される方向への力が発生され、伸縮素子が伸張される際にも充分な動作力を得ることができる。又．バイアス機構によって外力が吸収され移動部の無理な動作もなくなって、アクチュエータ本体は破損し難くなる。

【００２２】

【発明の実施の形態】図１は、本発明の請求項１～４に対応する一実施形態を示し．該実施形態のアクチュエータは．ポリアニン、ポリピロール等のπ共役型高分子材料でなる伸縮素子１と、該伸縮素子１に電圧を印加するための電源部２及び電圧印加部３と．電流を伸縮素子１から外部に導通させるための電解質部４と、を有し、電圧印加部３に正の電位を印加すると伸縮素子１が伸張し．電圧印加部３に負の電位を印加すると伸縮素子１が収縮するようになしたアクチュエータ本体５に．伸縮素子１の伸縮によって直線的に動作される移動部６を設けてなる。

【００２３】該実施形態のアクチュエータにおいては、伸縮素子１の伸張時に移動部６が動作される方向への力を発生するばね等のバイアス機構７を備えている。又、電解質部４の両側に伸縮素子1a、1bを接合一体化して板状積層体８を形成し、一方の伸縮素子1aに対応する電圧印加部3aに正の電位を印加すると共に．他方の伸縮素子1bに対応する電圧印加部3bに負の電位を印加することにより．一方の伸縮素子1aが伸張すると同時に他方の伸縮素子1bが収縮して、同板状積層体８が屈曲変形されるようになし、該屈曲変形によって移動部６が直線的に動作されるようになしている。又、この場合、対の板状積層体８．８を対向位置に配設して両板状積層体８．８を端部で結合一体化し、該結合部分に同板状積層体８．８の板面と略沿う方向で直線的に動作される移動部６を設けてもいる。

【００２４】電解質部３は銀イオン導電性結晶その他の固体電解質でなり、該電解質部３の両側にポリアニン、ポリピロール等のπ共役型高分子材料でなる伸縮素子1a、1bが接合一体化されて板状積層体８は形成されている。この場合．電解質部３として、陰イオンとしてある程度の分子量を有する、例えば、SO_4^{2-}を生じるH_2SO_4、Na_2SO_4や．Cl^-を生じるHCLや、F^-を生じるHPF_6、HBF_4等を採用することも可能ではあるが、電解質部３がイオン溶液のように流体となる場合には密封状態で用いる必要があるので、固体電解質を使用することが好ましい。

【００２５】両板状積層体８はその下端で移動部６にて結合一体化され．同上端では電圧印加部3b、3b間のスペーサ９を介して結合一体化されており．該スペーサ９と移動部６との間にスプリングでなるバイアス機構７が圧縮状態で張設されている。この場合．前記上端側に電源部２及び電圧印加部３が設けられ、該上端側が固定されて．前記下端の移動部６が上下方向に動作される。

【００２６】したがって．該実施形態のアクチュエータにおいては、電圧印加部３に正、負の電位が印加されることによってπ共役型高分子材料でなる伸縮素子１は酸化還元反応作用により強力に伸縮し．すなわち．電圧印加部３に正の電位を印加すると伸縮素子１のイオンドーピング量が増大して該伸縮素子１は伸張し、逆に．電圧印加部３に負の電位を印加すると伸縮素子１のイオンドーピング量が減少して該伸縮素子１は収縮し、これによって確実にアクチュエータ本体５に設けられる移動部６が直線的に動作される。しかも、同伸縮素子１はその伸張或いは収縮された状態を電圧印加部３に正、負逆の電位が印加されるまで保持するので、動作されたアクチュエータ本体５の形態を繰り返し電圧印加し続けることなく確実に持続させることができる。このような変形動作をなす該実施形態のアクチュエータは．例えば．超小型ロボット用の人工筋肉等の動力発生機構として好適に利用することができる。

【００２７】又．該実施形態のアクチュエータにおいては．外側の電圧印加部3aに負の電位が印加されて伸縮素子1aが収縮され．内側の電圧印加部3bに正の電位が印加されて伸縮素子1bが伸張されて、図１（ａ）に示す如く．両板状積層体８は伸展状態となり．その際．バイアス機構７によって移動部６が動作される下方への力が発生されるので．充分な動作力を得ることができる。又、外側の電圧印加部3aに正の電位が印加されて伸縮素子1aが伸張され、内側の電圧印加部3bに負の電位が印加されて伸縮素子1bが収縮されて．図１（ｂ）に示す如く、両板状積層体８は屈曲状態となり、その際、前記バイアス機構７の発生力に抗し支障なく移動部６は前記と逆の上方へ動作される。

【００２８】又．該実施形態のアクチュエータにおいては．電圧印加部３に正、負の電位が印加されることによって．板状積層体８の一方の伸縮素子1a(1b)が伸張すると同時に他方の伸縮素子1b(1a)が収縮し、これにより該板状積層体８が屈曲変形されることによって移動部６は直線的に動作されるので．電圧印加部３に正、負逆の電位を印加して同板状積層体８を反対側へ屈曲変形させる際にも同様の動作力が発生し、簡単な機構でもって移動部６を確実に往復運動させることができる。しかも、この場合、上記板状積層体８が対向配置されて両者の端部で結合一体化され、該結合部分に同板状積層体８の板面と略沿う方向で直線的に動作される移動部６が設けられているので、該移動部６を両側の板状積層体８の屈曲変形によって確実に安定した状態で上下方向に往復運動させることができる。

【００２９】図２は、本発明の請求項１～４に対応する別の実施形態を示し、該実施形態のアクチュエータにおいては、図２（ｃ）に示す如く、板状積層体８が湾曲片状に形成され．図２（ａ）（ｂ）に示す如く、同板状積層体８が結合具10を介して上下に連結され、該上下に連結されたものが．対にして対向位置に配設され．下側の両板状積層体８の下端部分が移動部６を介して結合一体化され、上側の両板状積層体８の上端部分間に共用される電圧印加部3bが介設されて、該電圧印加部3bと移動部６との間にバイアス機構７が張設されている。

【００３０】この場合、上記図１に示した実施形態におけるとは逆に．外側の電圧印加部3aに正の電位が印加されて伸縮素子1aが伸張され．内側の電圧印加部3bに負の電位が印加されて伸縮素子1bが収縮されて、図２（ａ）に示す如く、各板状積層体８は伸展状態となり．移動部６は下方へ動作される。又．外側の電圧印加部3aに負の電位が印加されて伸縮素子1aが収縮され、内側の電圧印加部3bに正の電位が印加されて伸縮素子1bが伸張されて．図２（ｂ）に示す如く．各板状積層体８は屈曲状態となり、移動部６は上方へ動作される。なお、それ以外は．上記図１に示した実施形態と同様に構成されており．同上記実施形態におけると同様の作用効果が奏される。

【００３１】図３は、本発明の請求項１、３、５に対応する更に別の実施形態を示し、該実施形態のアクチュエータにおいては．板状積層体８の中程部分に、該板状積層体８の板面と略直交する方向で直線的に動作される移動部６を設けている。この場合、板状積層体８はその両端部分が固定端部11として固定されて略水平状態に配置され．該板状積層体８の中央下面に移動部６が設けられている。

【００３２】したがって．実施形態のアクチュエータにおいては、電圧印加部3aに正の電位が印加されて上側の伸縮素子1aが伸張され、電圧印加部3bに負の電位が印加されて下側の伸縮素子1bが収縮されると、図３（ｂ）に示す如く、板状積層体８はその中程部分が上方へと反るように屈曲変形して移動部６は上方へ動作される。これとは逆に電位が印加されると、同板状積層体８はその中程部分が下方へと反るように屈曲変形して移動部６は下方へ動作される。又、電位の印加が停止されると．図３（ａ）に示す如く、同板状積層体８は中立の直線状態に保持される。すなわち、この場合は特に、移動部６を単一の板状積層体８でもってこれと略直交する方向に往復運動させることができる。なお、それ以外は、上記図１に示した実施形態と同様に構成されており、請求項１、３に係る作用効果が同上記実施形態におけると同様に奏される。

【００３３】図４は、本発明の請求項１～３、６に対応する更に別の実施形態を示し、該実施形態のアクチュエータにおいては．板状積層体８をその一方の伸縮素子1a

が外周、他方の伸縮素子1bが内周となる円環状に形成し．該円環状となる板状積層体８の周方向における一部分を．同板状積層体８の径方向で直線的に動作される移動部６となしている。この場合、円環状の板状積層体８の上端部分の外周側に電圧印加部3a．同上端部分の内周側に電圧印加部3bが配設されて、各々は伸縮素子1a、1bに接続されている。又、同板状積層体８の下端部分の内周側に移動部６が設けられ．該移動部６と前記電圧印加部3bとの間にバイアス機構７が張設されている。

【００３４】したがって．該実施形態のアクチュエータにおいては、電圧印加部3aに正の電位が印加されて外周側の伸縮素子1aが伸張され．電圧印加部3bに負の電位が印加されて内周側の伸縮素子1bが収縮されると．円環状の板状積層体８が縮小変形して移動部６は上方へ動作される。これとは逆に電位が印加されると、同板状積層体８が膨大変形して移動部６は下方へ動作され、その際、バイアス機構７によって移動部６が動作される下方への力が発生されるので、充分な動作力を得ることができる。

【００３５】すなわち、この場合は特に、板状積層体８が円環状に形成され、その周方向における下端部分に上下径方向で直線的に動作される移動部６が設けられて、該移動部６と反対側で径方向に対向する同板状積層体８の上端部分を固定するだけの簡単な構造となり．同移動部６を円環状の板状積層体８の膨大縮小変形によって確実に安定した状態で上下方向に往復運動させることができる。このような変形動作をなす該実施形態のアクチュエータは、例えば、指、腕等の圧迫マッサージ機の動力発生機構としても好適に利用することができる。なお、それ以外は、上記図１に示した実施形態と同様に構成されており、請求項１～３に係る作用効果が同上記実施形態におけると同様に奏される。

【００３６】又．該実施形態のアクチュエータは．図５に示す如く、ＳＴＡＧＥ13を二次元移動させる動作発生機構として好適に使用することもできる。この場合、円形状のＳＴＡＧＥ13の周囲に複数のアクチュエータ本体５が対向配置され、各アクチュエータ本体５に設けられる移動部６がＳＴＡＧＥ13の外周に接合され、各板状積層体８の同移動部６と反対側で径方向に対向する部分の外周側の伸縮素子1aに円環状枠体12の内周部分が接合されている。又．同円環状枠体12は導電性材料で形成され．一方の電圧印加部3aと電気的に接続されて．その内側に各アクチュエータ本体５を介してＳＴＡＧＥ13を保持するもので．各アクチュエータ本体５に設けられる移動部６には他方の電圧印加部3bが各々配設されて．いずれの電圧印加部3bに電圧を印加するかはセレクトスイッチ14によって選択変更することができる。したがって、この場合、セレクトスイッチ14を操作して、所定のアクチュエータ本体５の円環状の板状積層体８を前述したように膨大縮小変形させることにより．往復運動する移動

部６間に保持されるＳＴＡＧＥ13をＸＹ平面上で所望の方向へ動作させることができる。

【００３７】図６は、本発明の請求項１、７に対応する更に別の実施形態を示し、該実施形態のアクチュエータにおいては、単一の伸縮素子１をスパイラル状に形成し、該伸縮素子１のスパイラル曲線に沿う伸縮により同スパイラルの軸線方向に沿って直線的に動作される移動部６を、同伸縮素子１の端部に設けている。

【００３８】この場合、一方の電圧印加部3aが銅、銀、白金等で円柱棒状に形成され、該電圧印加部3aの外周面全体に電解質部４が層設され、該電解質部４の外周面に帯状の伸縮素子１が摺動自在となるようスパイラル状に巻装され、該伸縮素子１の上端に他方の電圧印加部3bが電気的に接続されて固定され、同伸縮素子１の下端に同電解質部４の下端部分に上下スライド自在に嵌装される短円筒状の移動部６が結合されている。

【００３９】したがって、該実施形態のアクチュエータにおいては、伸縮素子１がスパイラル状に形成されてコンパクトに納まる。又、伸縮素子１に接続される電圧印加部3bに正の電位が印加されると該伸縮素子１は伸張し、同電圧印加部3bに負の電位が印加されると同伸縮素子１は収縮する。その際、伸縮素子１はスパイラル曲線に沿って電解質部４の外周面に斜め周方向で摺接しながら大きな変位量で伸縮して、該大きな変位量の伸縮が同スパイラルの軸線方向（円柱棒状の長手方向）に沿った小さな変位量となる移動部６の直線的な上下方向の動作に変換され、より強い動作力を得ることができる。なお、それ以外は、上記図１に示した実施形態と同様に構成されており、請求項１に係る作用効果が同上記実施形態におけると同様に奏される。

【００４０】図７は、本発明の請求項１、７、８に対応する更に別の実施形態を示し、該実施形態のアクチュエータにおいては、上記スパイラル状の伸縮素子１の伸張時に移動部６が動作される下方への力を発生する同じスパイラル状のスプリングであるバイアス機構７を備え、該バイアス機構７に沿って同伸縮素子１を一体化している。この場合、図７（ｂ）に示す如く、バネ鋼材でなるバイアス機構７が一方の電圧印加部3aとして形成され、該バイアス機構７の外面全体に電解質部４を介して伸縮素子１が層設され、該伸縮素子１の外面全体に他方の電圧印加部3bが層設被装されている。

【００４１】したがって、該実施形態のアクチュエータにおいては、上記スパイラル状の伸縮素子１がスプリングであるバイアス機構７に沿ってこれと一体化形成されるので、該バイアス機構７によって伸縮素子１の伸張時に移動部６が動作される下方への力が発生され、伸縮素子１が伸張される際にも充分な動作力を得ることができる。又、バイアス機構７によって外力が吸収され移動部６の無理な動作もなくなって、アクチュエータ本体５は破損し難くなる。なお、それ以外は、上記図６に示した実施形態と同様に構成されており、同上記実施形態におけると同様の作用効果が奏される。

【００４２】

【発明の効果】上述の如く、本発明の請求項１記載のアクチュエータにおいては、電圧印加部に正、負の電位が印加されることによりπ共役型高分子材料でなる伸縮素子は強力に伸縮して、確実にアクチュエータ本体に設けられる移動部が直線的に動作され、しかも、該動作されたアクチュエータ本体の形態を繰り返し電圧印加し続けることなく確実に持続させることができる。

【００４３】又、本発明の請求項２記載のアクチュエータにおいては、特に、バイアス機構によって伸縮素子の伸張時に移動部が動作される方向への力が発生され、伸縮素子が伸張される際にも充分な動作力を得ることができ、又、伸縮素子が収縮される際には、支障なく伸縮素子が収縮して移動部は逆の方向へ動作される。

【００４４】又、本発明の請求項３記載のアクチュエータにおいては、特に、印加される電位を正、負変換することで、板状積層体が相反する側へ屈曲変形され、簡単な機構でもって移動部を確実に往復運動させることができる。

【００４５】又、本発明の請求項４記載のアクチュエータにおいては、特に、上記板状積層体が対向配置され、移動部を同両側の板状積層体の屈曲変形によって確実に安定した状態で往復運動させることができる。

【００４６】又、本発明の請求項５記載のアクチュエータにおいては、特に、上記板状積層体の中程部分に設けられる移動部を、単一の同板状積層体でもってこれと略直交する方向に往復運動させることができる。

【００４７】又、本発明の請求項６記載のアクチュエータにおいては、特に、上記板状積層体が円環状に形成され、その周方向における一部分となる移動部を、円環状の板状積層体が膨大縮小する屈曲変形によって確実に安定した状態で往復運動させることができる。

【００４８】又、本発明の請求項７記載のアクチュエータにおいては、特に、伸縮素子がスパイラル状に形成されてコンパクトに納まり、しかも、該伸縮素子のスパイラル状に沿った大きな変位量での伸縮が移動部の直線的な動作に変換され、より強い動作力を得ることができる。

【００４９】又、本発明の請求項８記載のアクチュエータにおいては、特に、上記スパイラル状の伸縮素子がスプリングであるバイアス機構と一体化形成されて、該伸縮素子が伸張される際にも充分な動作力を得ることができ、又、外力が吸収され移動部の無理な動作もなくなって、アクチュエータ本体は破損し難くなる。

【図面の簡単な説明】

【図１】本発明の一実施形態であるアクチュエータを示し、（ａ）（ｂ）はその各々異なる状態における側面図。

【図２】別の実施形態であるアクチュエータを示し、（ａ）（ｂ）はその各々異なる状態における側面図、（ｃ）はその板状積層体を示す斜視図。

【図３】更に別の実施形態であるアクチュエータを示し、（ａ）はその側面図、（ｂ）はその板状積層体が屈曲変形した状態を示す側面図。

【図４】更に別の実施形態であるアクチュエータを示し、（ａ）はその側面図、（ｂ）はその板状積層体を示す斜視図。

【図５】同アクチュエータの一使用形態を例示する平面図。

【図６】更に別の実施形態であるアクチュエータを示す斜視図。

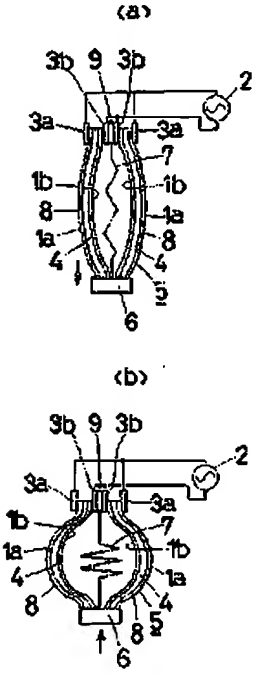
【図７】更に別の実施形態であるアクチュエータを示し、（ａ）はその斜視図、（ｂ）はその要部を示す拡大斜視図。

【図８】従来例であるアクチュエータを示す断面図。

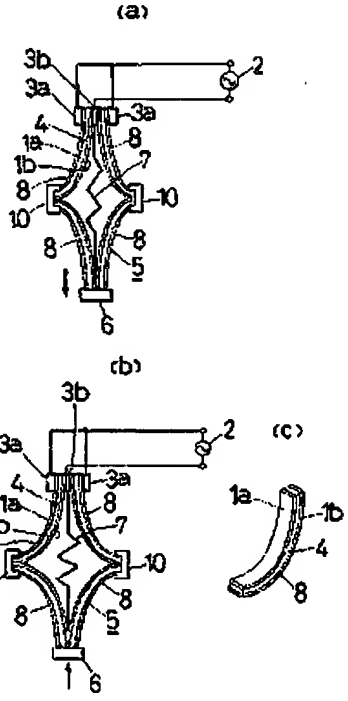
【符号の説明】

1 伸縮素子
2 電源部
3 電圧印加部
4 電解質部
5 アクチュエータ本体
6 移動部
7 バイアス機構
8 板状積層体

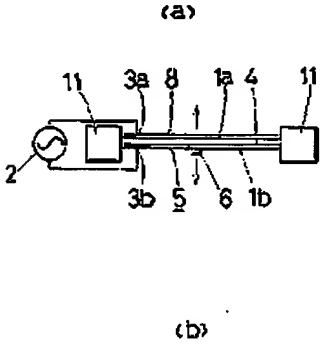
【図１】



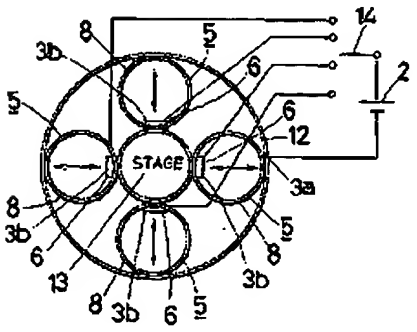
【図２】



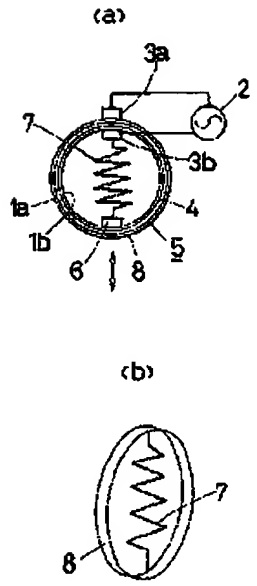
【図３】



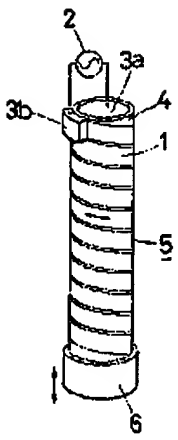
【図５】



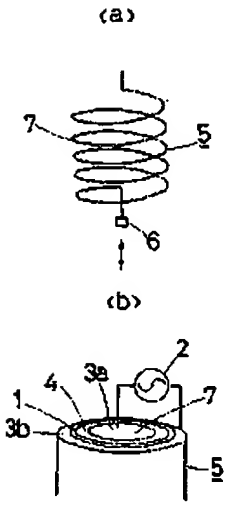
【図４】



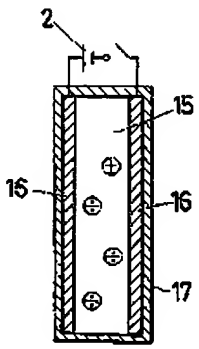
【図６】



【図７】



【図８】



フロントページの続き

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Ｆターム(参考)　3F060 GA00 GA01

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the actuator which obtains linear actuation by the flexible component expanded and contracted if an electrical potential difference is impressed within the environment of the electrolyte section.
[0002]
[Description of the Prior Art] From the former, the actuator as shown in JP,6-6991,A is known. As shown in drawing 8 , this actuator joins an electrode 16 to both sides of ion exchange membrane 15, and comes to prepare the polymer ingredient layer 17 which covers this etc. In this case, either cation exchange membrane or anion exchange membrane can be used as ion exchange membrane 15, the polystyrene sulfonate film, fluororesin system ion exchange membrane with a sulfone radical or a carboxyl group, etc. are used as cation exchange membrane, and the fluororesin system ion exchange membrane containing ammonium and others are used as anion exchange membrane. Moreover, the polymer ingredient layer 17 is a thin coat, and becomes by water-insoluble nature polymers, such as polyethylene, polystyrene, and BORIAMIDO.
[0003] Therefore, in this actuator, it is impressing an electrical potential difference to two electrodes 16 by the power supply section 2, and the potential difference is built over the front flesh side of ion exchange membrane 15, a difference is produced in the moisture content in this front flesh side, a side with low water content contracts and this ion exchange membrane 15 carries out curve deformation to this low ** side (cathode side). This actuator which makes such deformation actuation can be used as power developmental mechanics, such as an artificial muscle for micro robots.
[0004]
[Problem(s) to be Solved by the Invention] However, in the above-mentioned Prior art, although the polymer ingredient layer 17 will also be expanded and contracted by impression of an electrical potential difference, it was what reacts only to the transient build-up current at the time of electrical-potential-difference impression in this case, and returns to origin immediately. That is, even if it impressed the electrical potential difference, when the current in ion exchange membrane 15 decreased, in order that distribution of the once produced water content might be equalized gradually and might go, it was that from which a curve deformation condition returns to the original condition. So, in order to make the condition of having elongated or contracted maintain, there was a problem that impressing a repeat electrical potential difference had to be continued. Moreover, since it was that to which an actuator makes deformation actuation only by contraction of a side with the low water content of an ion exchange membrane 15, there was also a problem that the generating force at the time of this contraction required to obtain this deformation actuation was weak.
[0005] This invention is offering the actuator which can make the gestalt after having been invented in order to solve the problem in the above-mentioned Prior art entirely, and the technical problem's could obtain linear actuation certainly and this operating moreover maintain, without continuing carrying out repeat electrical-potential-difference impression.
[0006]
[Means for Solving the Problem] The flexible component which the actuator of this invention according to claim 1 becomes by pi conjugation mold polymeric materials, such as poly ANIN and polypyrrole, The power supply section for impressing an electrical potential difference to this flexible component and the electrical-potential-difference impression section, and the electrolyte section for making it flow through a current outside from a flexible component, It ****, if electropositive potential is impressed to the electrical-potential-difference impression section, a flexible component will develop, and it comes to prepare the migration section which operates linearly by telescopic motion of a flexible component on the body of an actuator made as contract / a flexible component] when electronegative potential was impressed to the electrical-potential-difference impression section.
[0007] Therefore, expand and contract powerfully the flexible component which becomes by pi conjugation mold polymeric materials by impressing forward and electronegative potential to the electrical-potential-difference impression section in this case according to an oxidation reduction reaction operation. Namely, if electropositive potential is impressed to the electrical-potential-difference impression section, the amount of ion doping of a flexible component will increase, and this flexible component will be elongated. On the contrary, if electronegative potential is impressed to the electrical-potential-difference impression section, the amount of ion doping of a flexible component will decrease, this flexible component will be contracted, and the migration section certainly prepared in the body of an actuator by this operates linearly. and this flexible component -- the condition of having elongated or contracted -- the electrical-potential-difference impression section -- forward and negative -- it can be made to continue certainly, since it holds until reverse potential is impressed, without

repeating the gestalt of the body of an actuator which operated and continuing carrying out electrical-potential-difference impression

[0008] The actuator of this invention according to claim 2 is characterized by having bias devices, such as a spring which generates the force to the direction where the migration section operates at the time of elongation of a flexible component, in the actuator of the claim 1 above-mentioned publication.

[0009] Therefore, although this elongation force at the time of electropositive potential being impressed to the electrical-potential-difference impression section especially in this case, and a flexible component being elongated becomes weaker than a shrinkage force when reverse, since the force to the direction where the migration section operates according to a bias device at the time of elongation of a flexible component is generated, also in case a flexible component is elongated, sufficient force of operation can be acquired. Moreover, since this shrinkage force at the time of a flexible component being contracted is comparatively strong, the generating force of said bias device is resisted, this flexible component contracts convenient, and the migration section operates in the direction contrary to the above.

[0010] The actuator of this invention according to claim 3 is set to the actuator of the claim 1 above-mentioned publication. While carrying out the junction unification of the flexible component, forming a tabular layered product in the both sides of the electrolyte section and impressing electropositive potential to the electrical-potential-difference impression section corresponding to one flexible component By impressing electronegative potential to the electrical-potential-difference impression section corresponding to the flexible component of another side, it is characterized by for the flexible component of another side having contracted, while one flexible component developed, and making as [operate / the migration section / so that this tabular layered product may be deformed by flexion / by nothing and this flexion deformity / linearly].

[0011] Therefore, by impressing forward and electronegative potential to the electrical-potential-difference impression section especially in this case Since the migration section operates linearly by the flexible component of another side contracting and deforming this tabular layered product by flexion by this at the same time one flexible component of a tabular layered product develops the electrical-potential-difference impression section -- forward and negative -- also in case reverse potential is impressed and this tabular layered product is deformed by flexion to the opposite side, the same force of operation can occur, and the migration section can be made to reciprocate certainly that it is also at an easy device

[0012] In the actuator of the claim 3 above-mentioned publication, the actuator of this invention according to claim 4 arranges a pair of tabular layered product in an opposite location, carries out the joint unification of both the tabular layered product at the end, and is characterized by preparing the migration section which operates linearly in the plate surface and the ****** direction of this tabular layered product to a part for this bond part.

[0013] Therefore, since the migration section to which opposite arrangement is carried out, joint unification is carried out at both edge, and the above-mentioned tabular layered product operates linearly in the plate surface and the ****** direction of this tabular layered product to a part for this bond part especially in this case is prepared, this migration section can be made to reciprocate in the condition of having been certainly stabilized by flexion deformity of the tabular layered product of both sides.

[0014] The actuator of this invention according to claim 5 is characterized by preparing the migration section which operates linearly into the middle part of a tabular layered product towards carrying out an abbreviation rectangular cross with the plate surface of this tabular layered product in the actuator of the claim 3 above-mentioned publication.

[0015] Therefore, since the migration section which operates linearly towards carrying out an abbreviation rectangular cross with the plate surface of this tabular layered product is prepared in the middle part of the above-mentioned tabular layered product, it can be made to reciprocate especially in this case in the direction which carries out an abbreviation rectangular cross to this single tabular layered product being about this migration section with this.

[0016] the shape of a circular ring from which, as for the actuator of this invention according to claim 6, a periphery and the flexible component of another side serve as [the flexible component of one of these] inner circumference in a tabular layered product in the actuator of the claim 3 above-mentioned publication -- forming -- this -- it is characterized by making the part in the hoop direction of a tabular layered product which becomes in a circle with the migration section which operates linearly in the direction of a path of this tabular layered product.

[0017] Therefore, since the above-mentioned tabular layered product is formed in the shape of a circular ring and the part in that hoop direction serves as the migration section which operates linearly in the direction of a path especially in this case It can become this migration section and the easy structure which fixes a part of this tabular layered product which counters in the direction of a path in the opposite side, and can be made to reciprocate in the condition of having been certainly stabilized by flexion deformity to which a tabular circular ring-like layered product carries out huge contraction of this migration section.

[0018] In the actuator of the claim 1 above-mentioned publication, the actuator of this invention according to claim 7 forms a flexible component in the shape of a spiral, and is characterized by preparing the migration section which operates linearly along the direction of an axis of this spiral by telescopic motion in alignment with the spiral curve of this flexible component in the edge of this flexible component.

[0019] therefore, a flexible component forms in the shape of a spiral especially in this case -- having -- a compact -- being settled -- moreover -- this flexible component -- a spiral curve -- meeting -- a big variation rate -- an amount -- expanding and contracting -- this size -- a **** variation rate -- the small variation rate to which telescopic motion of an amount met in the direction of an axis of this spiral -- since it is changed into the linear actuation of the migration section used as an amount, the stronger force of operation can be acquired.

[0020] In the actuator of the claim 7 above-mentioned publication, the actuator of this invention according to claim 8 is equipped with the bias device which is the spiral-like spring which generates the force to the direction where the migration section operates

at the time of elongation of a flexible component, and is characterized by unifying a flexible component in accordance with this bias device.

[0021] Therefore, since unification formation of the flexible spiral component of the above is carried out with this in accordance with the bias device which is a spring especially in this case, also in case the force to the direction where the migration section operates is generated and a flexible component is elongated by this bias device at the time of elongation of a flexible component, sufficient force of operation can be acquired. Moreover, external force is absorbed by the bias device, impossible actuation of the migration section is also lost, and it is hard coming to damage the body of an actuator.

[0022]

[Embodiment of the Invention] Drawing 1 shows 1 operation gestalt corresponding to claims 1-4 of this invention. The actuator of this operation gestalt The flexible component 1 which becomes by pi conjugation mold polymeric materials, such as poly ANIN and polypyrrole, The power supply section 2 and the electrical-potential-difference impression section 3 for impressing an electrical potential difference to this flexible component 1, It has the electrolyte section 4 for making it flow through a current outside from the flexible component 1. If electropositive potential is impressed to the electrical-potential-difference impression section 3, the flexible component 1 will develop, and it comes to prepare the migration section 6 which operates linearly by telescopic motion of the flexible component 1 on the body 5 of an actuator made as [contract / the flexible component 1] when electronegative potential was impressed to the electrical-potential-difference impression section 3.

[0023] In the actuator of this operation gestalt, it has the bias devices 7, such as a spring which generates the force to the direction where the migration section 6 operates at the time of elongation of the flexible component 1. Moreover, while carrying out the junction unification of the flexible components 1a and 1b, forming the tabular layered product 8 in the both sides of the electrolyte section 4 and impressing electropositive potential to electrical-potential-difference impression section 3a corresponding to one flexible component 1a By impressing electronegative potential to electrical-potential-difference impression section 3b corresponding to flexible component 1b of another side Flexible component 1b of another side contracts at the same time one flexible component 1a develops, and it is making as [operate / the migration section 6 / so that this tabular layered product 8 may be deformed by flexion / by nothing and this flexion deformity / linearly]. Moreover, a pair of tabular layered products 8 and 8 are arranged in an opposite location in this case, and the joint unification of both the tabular layered products 8 and 8 is carried out at the end, and even if it forms the migration section 6 which operates linearly to a part for this bond part in the plate surface and the ****** direction of these tabular layered products 8 and 8, it is.

[0024] The junction unification of the flexible components 1a and 1b which the electrolyte section 3 becomes with the solid electrolyte of a complex ion conductivity crystal and others, and become the both sides of this electrolyte section 3 by pi conjugation mold polymeric materials, such as poly ANIN and polypyrrole, is carried out, and the tabular layered product 8 is formed. in this case, for example, SO42- which has a certain amount of molecular weight as an anion as the electrolyte section 3 H2SO4 to produce and Na2 SO4 Cl- HCL to produce and F- HPF6 to produce and HBF4 etc., although adopting is also possible Since it is necessary to use in the state of seal when the electrolyte section 3 serves as a fluid like an ion solution, it is desirable to use a solid electrolyte.

[0025] The joint unification of both the tabular layered product 8 is carried out in the migration section 6 in the lower limit, at the edge same as the above, joint unification is carried out through the spacer 9 between electrical-potential-difference impression section 3b and 3b, and the bias device 7 which comes by the spring between this spacer 9 and the migration section 6 is stretched in the state of compression. In this case, a power supply section 2 and the electrical-potential-difference impression section 3 are formed in said upper limit side, this upper limit side is fixed, and the migration section 6 of said lower limit operates in the vertical direction.

[0026] Therefore, it sets to the actuator of this operation gestalt. Expand and contract powerfully the flexible component 1 which becomes by pi conjugation mold polymeric materials by impressing forward and electronegative potential to the electrical-potential-difference impression section 3 according to an oxidation reduction reaction operation. Namely, if electropositive potential is impressed to the electrical-potential-difference impression section 3, the amount of ion doping of the flexible component 1 will increase, and this flexible component 1 will be elongated. On the contrary, if electronegative potential is impressed to the electrical-potential-difference impression section 3, the amount of ion doping of the flexible component 1 will decrease, this flexible component 1 will be contracted, and the migration section 6 certainly prepared in the body 5 of an actuator by this operates linearly. and this flexible component 1 -- the condition of having elongated or contracted -- the electrical-potential-difference impression section 3 -- forward and negative -- it can be made to continue certainly, since it holds until reverse potential is impressed, without repeating the gestalt of the body 5 of an actuator which operated, and continuing carrying out electrical-potential-difference impression The actuator of this operation gestalt that makes such deformation actuation can be suitably used as power developmental mechanics, such as an artificial muscle for micro robots.

[0027] Moreover, it sets to the actuator of this operation gestalt. Electronegative potential is impressed to outside electrical-potential-difference impression section 3a, and flexible component 1a is contracted. Since both the tabular layered product 8 will be in an expansion condition and the force to the lower part in which the migration section 6 operates according to the bias device 7 is generated in that case as electropositive potential is impressed to inside electrical-potential-difference impression section 3b, flexible component 1b is elongated and it is shown in drawing 1 (a), sufficient force of operation can be acquired. Moreover, electropositive potential is impressed to outside electrical-potential-difference impression section 3a, and flexible component 1a is elongated. As electronegative potential is impressed to inside electrical-potential-difference impression section 3b, flexible component 1b is contracted and it is shown in drawing 1 (b), both the tabular layered product 8 will be in a crookedness condition, and in that case, the generating force of said bias device 7 is resisted, and it operates to the upper part

where it is convenient and the migration section 6 is contrary to the above.
[0028] Moreover, it sets to the actuator of this operation gestalt. Flexible component 1b (1a) of another side contracts at the same time one flexible component 1a (1b) of the tabular layered product 8 develops by impressing forward and electronegative potential to the electrical-potential-difference impression section 3. Since the migration section 6 operates linearly by deforming this tabular layered product 8 by flexion by this the electrical-potential-difference impression section 3 -- forward and negative -- also in case reverse potential is impressed and this tabular layered product 8 is deformed by flexion to the opposite side, the same force of operation can occur, and the migration section 6 can be made to reciprocate certainly that it is also at an easy device And opposite arrangement of the above-mentioned tabular layered product 8 is carried out in this case, joint unification is carried out at both edge, and since the migration section 6 which operates linearly to a part for this bond part in the plate surface and the ****** direction of this tabular layered product 8 is formed, this migration section 6 can be made to reciprocate in the vertical direction in the condition of having been certainly stabilized by flexion deformity of the tabular layered product 8 of both sides.
[0029] Drawing 2 shows another operation gestalt corresponding to claims 1-4 of this invention, and sets it to the actuator of this operation gestalt. As are shown in drawing 2 (c), and the tabular layered product 8 is formed in the shape of a piece of a curve and it is shown in drawing 2 (a) and (b) That by which this tabular layered product 8 was connected up and down through the joint implement 10, and was connected with these upper and lower sides It is made a pair, and it is arranged in an opposite location, the joint unification of the lower limit part of both the lower tabular layered product 8 is carried out through the migration section 6, electrical-potential-difference impression section 3b shared between the upper limit parts of both the upper tabular layered product 8 is interposed, and the bias device 7 is stretched between this electrical-potential-difference impression section 3b and the migration section 6.
[0030] In this case, as electropositive potential is conversely impressed to outside electrical-potential-difference impression section 3a as it can set in the operation gestalt shown in above-mentioned drawing 1 , flexible component 1a is elongated, electronegative potential is impressed to inside electrical-potential-difference impression section 3b, flexible component 1b is contracted and it is shown in drawing 2 (a), each tabular layered product 8 will be in an expansion condition, and the migration section 6 will operate below. Moreover, as electronegative potential is impressed to outside electrical-potential-difference impression section 3a, flexible component 1a is contracted, electropositive potential is impressed to inside electrical-potential-difference impression section 3b, flexible component 1b is elongated and it is shown in drawing 2 (b), each tabular layered product 8 will be in a crookedness condition, and the migration section 6 will operate upwards. In addition, except it, it is constituted like the operation gestalt shown in above-mentioned drawing 1 , and the same operation effectiveness is done so also in an account operation gestalt same as the above.
[0031] Drawing 3 showed still more nearly another operation gestalt corresponding to claims 1, 3, and 5 of this invention, and has formed the migration section 6 which operates linearly into the middle part of the tabular layered product 8 towards carrying out an abbreviation rectangular cross with the plate surface of this tabular layered product 8 in the actuator of this operation gestalt. In this case, a part for those both ends is fixed as the fixed-end section 11, the tabular layered product 8 is arranged at an abbreviation level condition, and the migration section 6 is formed in the central inferior surface of tongue of this tabular layered product 8.
[0032] Therefore, it sets to the actuator of an operation gestalt. If electropositive potential is impressed to electrical-potential-difference impression section 3a, upper flexible component 1a is elongated, electronegative potential is impressed to electrical-potential-difference impression section 3b and lower flexible component 1b is contracted As shown in drawing 3 (b), the tabular layered product 8 is deformed by flexion so that a part may curve upwards the middle, and the migration section 6 operates upwards. If potential is impressed contrary to this, this tabular layered product 8 will be deformed by flexion so that a part may curve below the middle, and the migration section 6 will operate below. Moreover, a halt of impression of potential holds this tabular layered product 8 at a neutral straight-line condition, as shown in drawing 3 (a). That is, it can be made to reciprocate in the direction which carries out an abbreviation rectangular cross to the single tabular layered product 8 being about the migration section 6 with this especially in this case. In addition, except it, it is constituted like the operation gestalt shown in above-mentioned drawing 1 , and the operation effectiveness concerning claims 1 and 3 is similarly done so in an account operation gestalt same as the above.
[0033] drawing 4 -- claim 1- of this invention -- the shape of a circular ring from which still more nearly another operation gestalt corresponding to 3 and 6 is shown, and flexible component 1b of a periphery and another side becomes [flexible component 1a of one of these] inner circumference about the tabular layered product 8 in the actuator of this operation gestalt -- forming -- this -- the part in the hoop direction of the tabular layered product 8 which becomes in a circle is made with the migration section 6 which operates linearly in the direction of a path of this tabular layered product 8. In this case, electrical-potential-difference impression section 3b is arranged in the periphery side of the upper limit part of the tabular circular ring-like layered product 8 at the inner circumference side of electrical-potential-difference impression section 3a and an edge part same as the above, and each is connected to the flexible components 1a and 1b. Moreover, the migration section 6 is formed in the inner circumference side of the lower limit part of this tabular layered product 8, and the bias device 7 is stretched between this migration section 6 and said electrical-potential-difference impression section 3b.
[0034] Therefore, in the actuator of this operation gestalt, if electropositive potential is impressed to electrical-potential-difference impression section 3a, flexible component 1a by the side of a periphery is elongated, electronegative potential is impressed to electrical-potential-difference impression section 3b and flexible component 1b by the side of inner circumference is contracted, the tabular circular ring-like layered product 8 will carry out contraction deformation, and the migration section 6 will operate upwards. If potential is impressed contrary to this, since the force to the lower part in

which this tabular layered product 8 carries out huge deformation, the migration section 6 operates below, and the migration section 6 operates according to the bias device 7 in that case will be generated, sufficient force of operation can be acquired.
[0035] Namely, especially in this case, the tabular layered product 8 is formed in the shape of a circular ring, and the migration section 6 which operates linearly in the direction of the diameter of the upper and lower sides into the lower limit part in that hoop direction is formed. It can become this migration section 6 and the easy structure which fixes the upper limit part of this tabular layered product 8 which counters in the direction of a path in the opposite side, and this migration section 6 can be made to reciprocate in the vertical direction in the condition of having been certainly stabilized according to huge contraction deformation of the tabular circular ring-like layered product 8. The actuator of this operation gestalt that makes such deformation actuation can be suitably used also as power developmental mechanics of pressure massage machines, such as a finger and an arm. In addition, except it, it is constituted like the operation gestalt shown in above-mentioned drawing 1 , and the operation effectiveness concerning claims 1-3 is similarly done so in an account operation gestalt same as the above.
[0036] Moreover, the actuator of this operation gestalt can also be suitably used as developmental mechanics of operation to which 2-dimensional STAGE13 is moved, as shown in drawing 5 . In this case, the migration section 6 which opposite arrangement of two or more bodies 5 of an actuator is carried out, and is prepared in the perimeter of STAGE13 of a circle configuration at each body 5 of an actuator is joined to the periphery of STAGE13, and the inner circumference part of the frame 12 in a circle is joined to flexible component 1a by the side of the periphery of the part which counters in the direction of a path in this migration section 6 and the opposite side of each tabular layered product 8. Moreover, it is what the frame 12 in a circle is formed with a conductive ingredient, is electrically connected with one electrical-potential-difference impression section 3a, and holds STAGE13 through each body 5 of an actuator to the inside. Electrical-potential-difference impression section 3b of another side is respectively arranged in the migration section 6 prepared in each body 5 of an actuator, and a selection change of whether an electrical potential difference is impressed to which electrical-potential-difference impression section 3b can be made with a select switch 14. Therefore, STAGE13 held between the reciprocating migration sections 6 can be operated towards desired on XY flat surface by operating a select switch 14 in this case, and carrying out huge contraction deformation, as the tabular layered product 8 of the shape of a circular ring of the predetermined body 5 of an actuator was mentioned above.
[0037] Drawing 6 showed still more nearly another operation gestalt corresponding to claims 1 and 7 of this invention, formed the single flexible component 1 in the shape of a spiral in the actuator of this operation gestalt, and has formed the migration section 6 which operates linearly along the direction of an axis of this spiral by telescopic motion in alignment with the spiral curve of this flexible component 1 in the edge of this flexible component 1.
[0038] In this case, one electrical-potential-difference impression section 3a is formed in the shape of a cylinder rod with copper, silver, platinum, etc. The electrolyte section 4 is ****(ed) by the whole peripheral face of this electrical-potential-difference impression section 3a, and it is looped around in the shape of a spiral so that sliding of the band-like flexible component 1 may be attained at the peripheral face of this electrolyte section 4. It connects with the upper limit of this flexible component 1 electrically, electrical-potential-difference impression section 3b of another side is fixed to it, and the migration section 6 of the shape of a short cylinder fitted in the lower limit of this flexible component 1 free [a vertical slide into the lower limit part of this electrolyte section 4] is combined.
[0039] Therefore, in the actuator of this operation gestalt, the flexible component 1 is formed in the shape of a spiral, and is restored to a compact. Moreover, if electropositive potential is impressed to electrical-potential-difference impression section 3b connected to the flexible component 1, this flexible component 1 will be elongated, and if electronegative potential is impressed to said electrical-potential-difference impression section 3b, this flexible component 1 will be contracted. while the flexible component 1 ****s to the peripheral face of the electrolyte section 4 along with a spiral curve in a slanting hoop direction in that case -- a big variation rate -- an amount -- expanding and contracting -- this size -- a **** variation rate -- the small variation rate to which telescopic motion of an amount met in the direction of an axis of this spiral (cylinder rod-like longitudinal direction) -- it is changed into actuation of the linear vertical direction of the migration section 6 used as an amount, and the stronger force of operation can be acquired. In addition, except it, it is constituted like the operation gestalt shown in above-mentioned drawing 1 , and the operation effectiveness concerning claim 1 is similarly done so in an account operation gestalt same as the above.
[0040] Drawing 7 shows still more nearly another operation gestalt corresponding to claims 1, 7, and 8 of this invention, is equipped with the bias device 7 which is the spring of the shape of same spiral which generates the force to the lower part in which the migration section 6 operates at the time of elongation of the flexible spiral component 1 of the above in the actuator of this operation gestalt, and is unifying this flexible component 1 in accordance with this bias device 7. In this case, as shown in drawing 7 (b), the bias device 7 which becomes with spring steel materials is formed as one electrical-potential-difference impression section 3a, the flexible component 1 is ****(ed) by the whole external surface of this bias device 7 through the electrolyte section 4, and **** covering of the electrical-potential-difference impression section 3b of another side is carried out on the whole external surface of this flexible component 1.
[0041] Therefore, in the actuator of this operation gestalt, since unification formation of the flexible spiral component 1 of the above is carried out with this in accordance with the bias device 7 which is a spring, also in case the force to the lower part in which the migration section 6 operates is generated and the flexible component 1 is elongated by this bias device 7 at the time of elongation of the flexible component 1, sufficient force of operation can be acquired. Moreover, external force is absorbed by the bias device 7, impossible actuation of the migration section 6 is also lost, and it is hard coming to damage the body 5 of an actuator. In addition, except it, it is constituted like the operation gestalt shown in above-mentioned drawing 6 , and the same operation effectiveness is done so also in an account operation gestalt same as the above.
[0042]

[Effect of the Invention] It expands and contracts powerfully and the migration section certainly prepared in the body of an actuator operates linearly, and moreover, the flexible component which becomes by pi conjugation mold polymeric materials by impressing forward and electronegative potential to the electrical-potential-difference impression section in [like / ****] the actuator of this invention according to claim 1 can be made to maintain certainly, without repeating the gestalt of the body of an actuator which this operated, and continuing carrying out electrical-potential-difference impression.

[0043] Moreover, especially in the actuator of this invention according to claim 2, in case the force to the direction where the migration section operates according to a bias device at the time of elongation of a flexible component is generated, sufficient force of operation can be acquired also in case a flexible component is elongated, and a flexible component is contracted, a flexible component contracts convenient and the migration section operates in the reverse direction.

[0044] Moreover, it is deformed by flexion to the side with which a tabular layered product disagrees the potential impressed by forward and carrying out negative conversion, and the migration section can be made to reciprocate certainly that it is also at an easy device especially in the actuator of this invention according to claim 3.

[0045] Moreover, opposite arrangement is carried out and the above-mentioned tabular layered product can make the migration section reciprocate especially in the actuator of this invention according to claim 4 in the condition of having been certainly stabilized by flexion deformity of the tabular layered product of these both sides.

[0046] Moreover, it can be made to reciprocate in the direction which carries out an abbreviation rectangular cross to this single tabular layered product being about the migration section prepared in the middle part of the above-mentioned tabular layered product with this especially in the actuator of this invention according to claim 5.

[0047] Moreover, the above-mentioned tabular layered product is formed in the shape of a circular ring, and a tabular circular ring-like layered product can make the migration section in the hoop direction which becomes a part reciprocate especially in the actuator of this invention according to claim 6 in the condition of having been certainly stabilized by flexion deformity which carries out huge contraction.

[0048] Moreover, especially in the actuator of this invention according to claim 7, a flexible component is formed in the shape of a spiral, and is restored to a compact, moreover telescopic motion in the big amount of displacement which met in the shape of of this flexible component] a spiral is changed into linear actuation of the migration section, and the stronger force of operation can be acquired.

[0049] Moreover, especially in the actuator of this invention according to claim 8, unification formation is carried out with the bias device in which the flexible spiral component of the above is a spring, also in case this flexible component is elongated, sufficient force of operation can be acquired, and external force is absorbed, impossible actuation of the migration section is also lost, and it is hard coming to damage the body of an actuator.

[Translation done.]

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The flexible component which becomes by pi conjugation mold polymeric materials, such as poly ANIN and polypyrrole, The power supply section for impressing an electrical potential difference to this flexible component and the electrical-potential-difference impression section, and the electrolyte section for making it flow through a current outside from a flexible component, The actuator which comes to prepare the migration section which operates linearly by telescopic motion of a flexible component on the body of an actuator made as [contract / a flexible component] when it ****(ed), the flexible component developed when electropositive potential was impressed to the electrical-potential-difference impression section, and electronegative potential was impressed to the electrical-potential-difference impression section.
[Claim 2] The actuator according to claim 1 characterized by having bias devices, such as a spring which generates the force to the direction where the migration section operates, at the time of elongation of a flexible component.
[Claim 3] While carrying out the junction unification of the flexible component, forming a tabular layered product in the both sides of the electrolyte section and impressing electropositive potential to the electrical-potential-difference impression section corresponding to one flexible component By impressing electronegative potential to the electrical-potential-difference impression section corresponding to the flexible component of another side The actuator according to claim 1 characterized by for the flexible component of another side having contracted while one flexible component developed, and making as [operate / the migration section / so that this tabular layered product may be deformed by flexion / by nothing and this flexion deformity / linearly].
[Claim 4] The actuator according to claim 3 which arranges a pair of tabular layered product in an opposite location, carries out the joint unification of both the tabular layered product at the end, and is characterized by preparing the migration section which operates linearly in the plate surface and the ****** direction of this tabular layered product to a part for this bond part.
[Claim 5] The actuator according to claim 3 characterized by preparing the migration section which operates linearly into the middle part of a tabular layered product towards carrying out an abbreviation rectangular cross with the plate surface of this tabular layered product.
[Claim 6] the shape of a circular ring from which a periphery and the flexible component of another side serve as [the flexible component of one of these] inner circumference in a tabular layered product -- forming -- this -- the actuator according to claim 3 characterized by making the part in the hoop direction of a tabular layered product which becomes in a circle with the migration section which operates linearly in the direction of a path of this tabular layered product.
[Claim 7] The actuator according to claim 1 characterized by preparing the migration section which operates linearly along the direction of an axis of this spiral by telescopic motion which forms a flexible component in the shape of a spiral, and meets the spiral curve of this flexible component in the edge of this flexible component.
[Claim 8] The actuator according to claim 7 characterized by having had the bias device which is the spiral-like spring which generates the force to the direction where the migration section operates at the time of elongation of a flexible component, and uniting a flexible component with it in accordance with this bias device.

[Translation done.]